9. HAMA HAMA-DUCKABUSH-DOSEWALLIPS CONSERVATION UNIT

9.1. Introduction

The Hama Hama-Duckabush-Dosewallips Conservation Unit includes the Hama Hama, Duckabush, and Dosewallips River watersheds, their estuaries, the marine nearshore areas around these areas and the mid Hood Canal marine waters. In terms of the summer chum salmon stocks, "isolation by distance" best explains their genetic and population structure (Currens 2004 draft in progress).

As geographic distance increases between the spawning aggregations, fewer migrants are exchanged. Currens (2004) has determined that the greatest genetic exchange was between the spawning aggregations of central Hood Canal, which includes those occupying the Hama Hama, Duckabush, and Dosewallips Rivers (less than a 25 km spread between all three systems). Genetic analysis presented in Washington Department of Fish & Wildlife and Point No Point Treaty Tribes (2000) shows samples from native summer chum of the Hama Hama River to be significantly different from samples of other Hood Canal areas, except for Quilcene Bay/River. Due to the relatively large geographic distance between the Hama Hama River and Quilcene Bay (with both the Dosewallips and Duckabush rivers located in between) WDFW and PNPTT (2000) argues against the possibility of the Hama Hama and the Quilcene Bay populations being a single stock.

An examination of genetic information for the native Duckabush summer chum stock indicates it is significantly different from other Hood Canal summer chum populations, except for the Hama Hama (WDFW and PNPTT 2000). The finding of no significant difference does not necessarily mean these two populations are of the same stock. It is only an indication that they might be from the same population. In the case of Duckabush, geographic distance between the Duckabush and the Hama Hama, and between the Duckabush and other summer chum populations, appears sufficient to categorize Duckabush as a separate stock. The geographic differences between the Duckabush and other summer chum streams appear sufficient, when comparisons are made with geographic distances between other stocks identified as significantly different by genetic analysis (e.g., between the Dosewallips and the Big Quilcene/Little Quilcene stocks). More genetic analysis is in process for these stocks, but will not be available for inclusion in this Salmon Recovery Plan (SRP).

Lestelle et al (2005a), surmise that the Hama Hama, Duckabush, and Dosewallips are three of five extant Hood Canal summer chum salmon populations (Quilcene, Lilliwaup, Hama Hama, Duckabush, Dosewallips) that had large escapements prior to about 1980. That was followed by severe drops in abundance until the mid to late 1990s, when escapement began to climb again. The consistent pattern amongst these five stocks is attributed to (from Lestelle, et. al. 2005a):

- Favorable ocean conditions for marine survival until the mid 1970s, followed by a regime shift in the ocean that was unfavorable for survival until near the turn of the century, when conditions switched again to favor marine survival;
- Low harvest rates prior to the mid 1970s, followed by steadily increasing rates on Hood Canal populations, sometimes exceeding 80% and averaging close to 60% in the 1980s; harvest rates fell sharply in the mid 1990s and were at very low levels again when ocean survival conditions turned favorable;
- Hatchery supplementation fish beginning to return to the Quilcene system in 1995, and several years later to the Hama Hama and Lilliwaup systems, roughly near or corresponding to the period of improving ocean conditions and low harvest rates; although no directed supplementation has occurred in the Dosewallips or Duckabush systems, some stray hatchery fish are suspected to have entered those streams in the late 1990s.

Current habitat conditions and situations were assessed using a variety of sources. Several sources were used to assess the summer chum salmon stocks in the Eastern Strait of Juan de Fuca conservation unit. This Salmon Recovery Plan (SRP) will not repeat the details of these assessments, but instead refers the reader to the cited documents. All material and documents referenced in this SRP should be considered part of, and integral to, the recovery of summer chum salmon. These sources provided the primary reference and knowledge base for development of these aspects of the SRP. Details of the EDT assessments for the Eastern Strait of Juan de Fuca stocks, including a summary of the baseline performance measures, and a summary of strategic priorities, are provided in Lestelle et al, (2005a) (see Appendix A). The EDT Method is a widely used tool to help prioritize habitat restoration and protection measures for salmon populations. It provides a systematic way of diagnosing habitat conditions that have contributed to the current state of populations, and it enables an assessment of priorities for developing restoration and protection plans. It also provides an analytical procedure for assessing the potential benefits to salmon populations of actions that might be taken to address habitat related issues impeding recovery. Other detailed assessments of habitat and environmental conditions are provided in the SCSCI (WDFW and PNPTT 2000), Correa (2002), and May and Peterson (2003).

The Hama Hama, Duckabush, and Dosewallips are three of the six core stocks that comprise the Hood Canal summer chum salmon population, as identified by the Puget Sound Technical Recovery Team (PSTRT) (Currens 2004 Draft in progress). Low channel complexity, estuarine habitat loss and degradation, riparian degradation, and freshwater wetland loss, appear to be the principal factors associated with the decline of summer chum in the Hama Hama, Duckabush, and Dosewallips watersheds. Like other west Hood Canal watersheds, the Hama Hama, Duckabush and Dosewallips are remote from development pressures, and much of their headwaters are managed by public

agencies with mandates for the conservation of indigenous species. However, development pressures are highly concentrated in and around the lower river areas, where most summer chum use occurs. Nonetheless, compared to other Hood Canal and eastern Strait of Juan de Fuca watersheds, prospects for the recovery of summer chum are good. On the Hama Hama, one family owns most of the land in the lower reaches of the river, where summer chum spawn, which simplifies potential public-private conservation efforts. Although summer chum habitat in the Hama Hama is presently altered, compared to historic conditions, current conditions are not beyond recovery and past escapement estimates indicate the watershed has strong summer chum production potential.

May and Peterson (2003) have rated the lower Duckabush, the Duckabush estuary, the lower Dosewallips River and the north side of the Dosewallips estuary as "priority refugia with natural ecological integrity." The south side of the Dosewallips estuary is rated as "potential refugia with altered ecological integrity." The potential refugia rating means that the habitat has been highly modified by drainage modifications, channelization, and conversion for residential purposes. This area is determined to be a good candidate for restoration.

Priority action recommendations developed in this SRP will focus initially on the lower two miles of rivers, where spawning and rearing tend to occur, and the estuarine areas. Actions in the upstream areas of the watersheds will require assessments to determine impacts and limiting factors that contribute to degradation in the lower reaches. Protection, restoration and maintenance of the Hama Hama, Duckabush, and Dosewallips watersheds are of paramount importance. In these watersheds, the lower river sections and the estuaries are targeted for restoration. These areas must be restored and protected to effect and ensure recovery of the Hood Canal population aggregation.

9.2. Geographic Description & Human Population Distribution

The Hama Hama-Duckabush-Dosewallips Conservation Unit includes the Hama Hama, Duckabush, and Dosewallips River watersheds. The marine nearshore waters are also included. They start at the mouth and estuary of the Hama Hama River, and moving north along the west side of Hood Canal, encompass the Duckabush and Dosewallips River estuaries. Off shore areas of mid Hood Canal waters are also included in this conservation unit.

The upper two thirds of this conservation unit is within eastern Jefferson County and includes most of the Dosewallips and Duckabush watersheds. The lower third lies within Mason County and includes most of the Hama Hama watershed.

Figure 9.1 provides a map of the Hama Hama-Duckabush-Dosewallips Conservation Unit. The Hama Hama watershed covers an area of 85 square miles with 18 miles of mainstem river length. The Duckabush River flows for a total mainstem length of 25 miles and covers 75 square miles. The total length of the Dosewallips River mainstem is 28 miles with a watershed area of 112 square miles. Detailed descriptions of each of these watersheds can be found in the Summer Chum Salmon Conservation Initiative (SCSCI) Appendix 3.6 (WDFW and PNPTT 2000), and the WRIA 16 limiting factors report (Correa 2003).

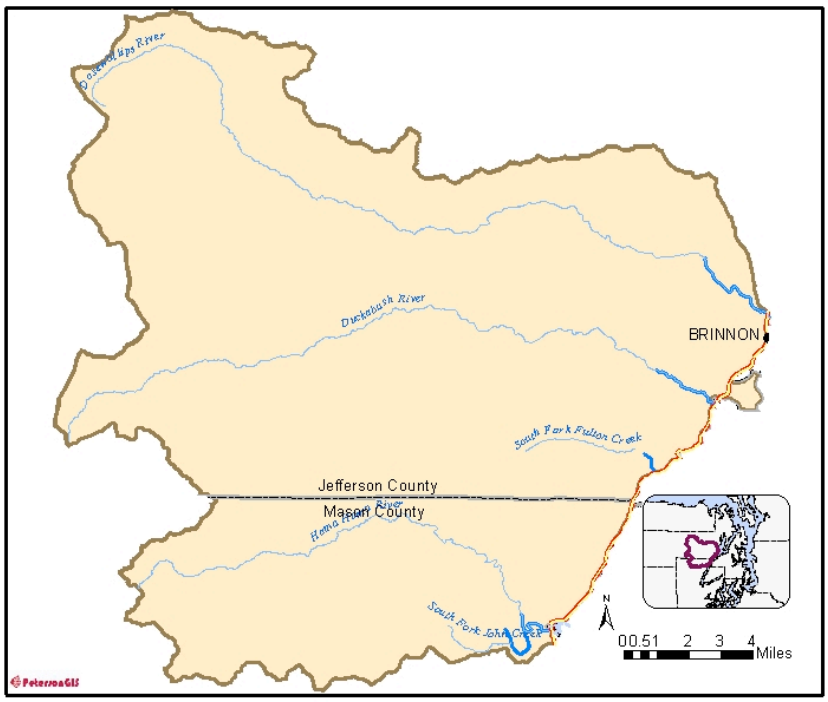

Figure 9.1. Hama Hama-Duckabush-Dosewallips Conservation Unit (map produced by Gretchen Peterson, Peterson GIS).

The unincorporated town of Brinnon, located at the mouth of the Dosewallips River, is the major area of human settlement in this unit. Population density throughout this conservation unit is relatively low.

Figure 9.2 shows that population density. Human population density relative to summer chum salmon distribution is generally low in this conservation unit, with the exception of the Brinnon area.

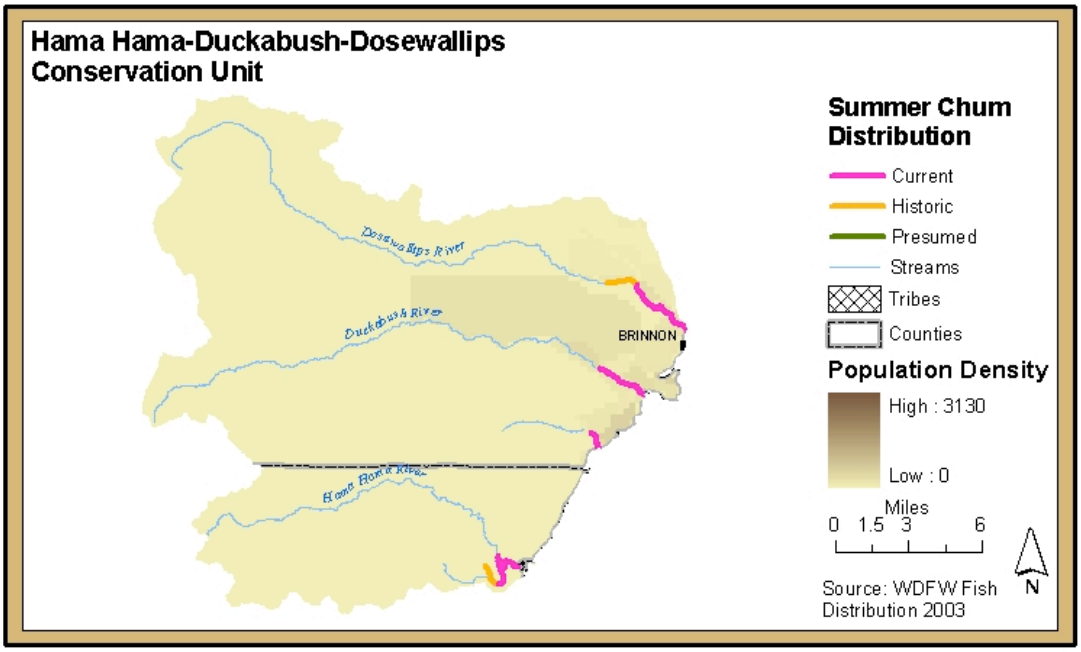

Figure 9.2. Human population density (people per square mile) for the Hama Hama-Duckabush-Dosewallips Conservation Unit (map produced by Gretchen Peterson, Peterson GIS).

9.3. Summer Chum Salmon Stocks' Description & Distribution

Several sources were used to assess the summer chum salmon stocks in the Hama Hama-Duckabush-Dosewallips conservation unit. This SRP will not repeat the details of these assessments, but instead refers the reader to the cited documents. All material and documents referenced in this SRP should be considered part of and integral to the recovery of summer chum salmon. The reader is urged to review the SCSCI (WDFW and PNPTT 2000) and subsequent supplemental reports. Summer chum salmon in Hood Canal and the Eastern Strait of Juan de Fuca were also assessed based on application of the Ecosystem Diagnostic and Treatment (EDT) Method. The EDT Method is a widely used tool to assist in the prioritization of habitat restoration and protection measures for salmon populations. EDT provides a systematic way of diagnosing habitat conditions that have contributed to the current state of fish populations. It enables an assessment of priorities for developing restoration and protection plans. It also provides an analytical procedure for assessing the potential benefits of actions that might be taken to address salmon habitat problems (Lestelle et al 2005). The complete detailed EDT for summer chum salmon can be found at http://www.wa.gov/hccc/ and click on the Salmon Recovery Planning Activities link. On that page can be found links to various documents and the

EDT web site for summer chum salmon. The web address for the EDT site: www.mobrand.com/edt/sponsors/show_sponsor.jsp?sponsor_id=11

9.3.1. Stocks' Status & Trends

Naturally produced summer chum salmon, originating from the Hama Hama-Duckabush-Dosewallips Conservation Unit, are likely produced in the Hama Hama, Duckabush and Dosewallips watersheds (WDFW and PNPTT 2000). Summer chum spawn in the mainstem of the Hama Hama River up to river mile (RM) 2 and in the lower 1.8 miles of John Creek (a tributary). Most spawning occurs below RM 1.8 in the Hama Hama and below RM 0.3 in John Creek. Spawning in the Duckabush River occurs in the mainstem up to RM 3.5 with the majority spawning below RM 2.2. Spawning in the Dosewallips is limited to the lower 4.3 miles with the majority of spawning occurring below RM 2.5

Current, historic and presumed summer chum salmon distribution in the Hama Hama-Duckabush-Dosewallips Conservation Unit is shown in Figure 9.3.

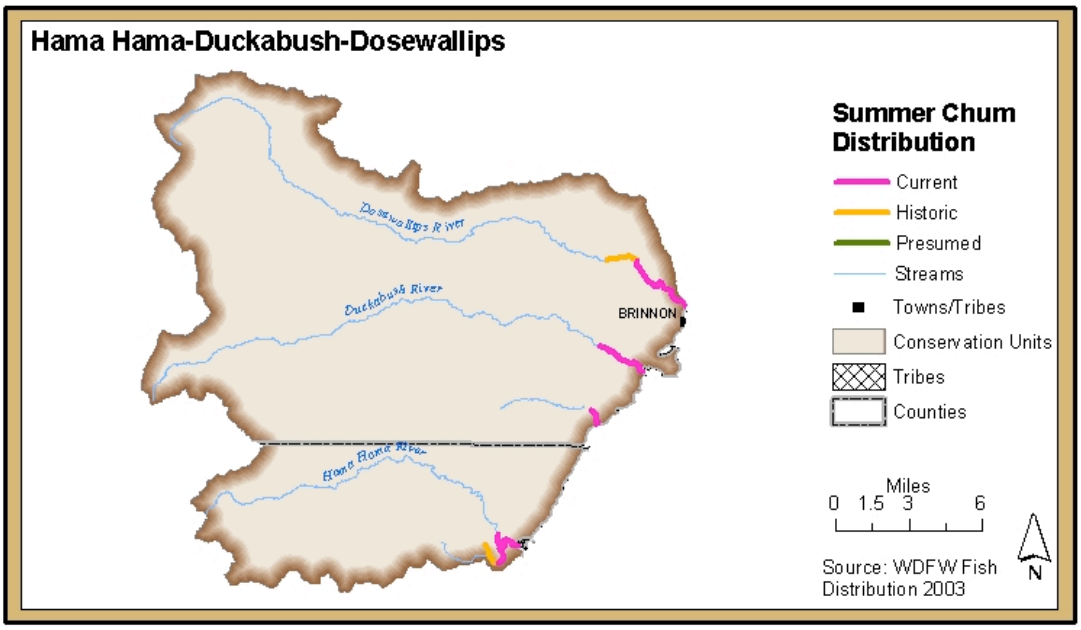

Figure 9.3. Map of the Hama Hama-Duckabush-Dosewallips Conservation Unit showing current, historic and presumed summer chum salmon distribution.

Summer chum salmon produced from the Hama Hama, Duckabush, and Dosewallips Rivers are part of the Hood Canal population targeted for recovery by the PSTRT. The Hood Canal population is one of two independent summer chum populations tentatively identified by the PSTRT (Currens 2004 Draft in progress). Currens (2004 Draft in progress) provides a detailed analysis of these conclusions. It speculates on the importance of the historical geographic distribution of summer chum salmon habitat and the overall "isolation-by-distance

relationship" that seems to be observed in the summer chum salmon aggregations. More analyses of population identification and viability are expected from the PSTRT. At this time it is not expected that this further analyses will affect the basic approach taken for recovery in this SRP. PNPTT and WDFW (2003) have identified the naturally produced stocks in the Hama Hama, Duckabush, and Dosewallips Rivers that should be targeted for recovery. The Hama Hama, Duckabush, and Dosewallips stocks are three of the six stocks that comprise the PSTRT designated Hood Canal aggregation. The co-manager interim recovery goals for these stocks are presented in Table 9.1.

Table 9.1. Hood Canal aggregation: co-manager interim abundance and escapement recovery goals for the Hama Hama, Duckabush, and Dosewallips spawning aggregations.

Stocks	Abundance	Escapement
Hama Hama	6,060	3,790
Duckabush	3,290	2,060
Dosewallips	3,080	1,930

PNPTT and WDFW (2003) also developed abundance and spawning escapement threshold criteria for recovery. Abundance is defined as the size of the run or the number of recruits. Recruits are the number of fish (in this case summer chum salmon from the Hood Canal/Eastern Strait of Juan de Fuca ESU geographic area) available for all fisheries in any given year. Escapement is defined as the number of adults that return to the natal spawning grounds (they escaped all fisheries and are available to spawn). One of the criterion for recovery is that each summer chum stock (Hama Hama, Duckabush, Dosewallips) must, over a minimum of the recent twelve year period, have both a mean abundance and mean escapement of natural-origin recruits that meets or exceeds the defined thresholds. Table 9.2 provides a summary of escapement for the recent twelve year period, 1993-2004, for the three stocks of concern in the Hama Hama-Duckabush-Dosewallips conservation unit.

Table 9.2. Escapement thresholds for the Hama Hama, Duckabush, and Dosewallips spawning aggregations based on PNPTT and WDFW (2003).

	ESCAPEMENT				
Population aggregation	**93-04 Average**	**target**	**% of target**	**# times below target 2001-2004 (≤1)**	**# times below target 1997-2004 (≤2)**
Hama Hama	792	3790	21%	4	8
Duckabush	1423	2060	69%	3	7
Dosewallips	2777	1930	144%	2	6

Of the three stocks from this conservation unit, only the Dosewallips currently exceeds the escapement threshold, as established by the co-managers; however, to meet the recovery goal 12-year criterion, only natural origin escapement must be counted. Additional criteria require that the stocks do not

fall below the target in more than once in the recent four-year period and no more than twice in the recent eight-year period. None of the three spawning aggregations meet the criteria for the recent four-year and eight-year periods. It should be noted that criteria for productivity (for example, most recent eight year average equal to or greater than 1.6 recruits per spawner) also must be met for recovery. Data currently are insufficient to assess the productivity criteria but are being collected (PNPTT and WDFW 2003).

Summer chum salmon escapement (number of adults returning to spawn) for the Hama Hama River from the years 1974-2004 is presented in Figures 9.4.

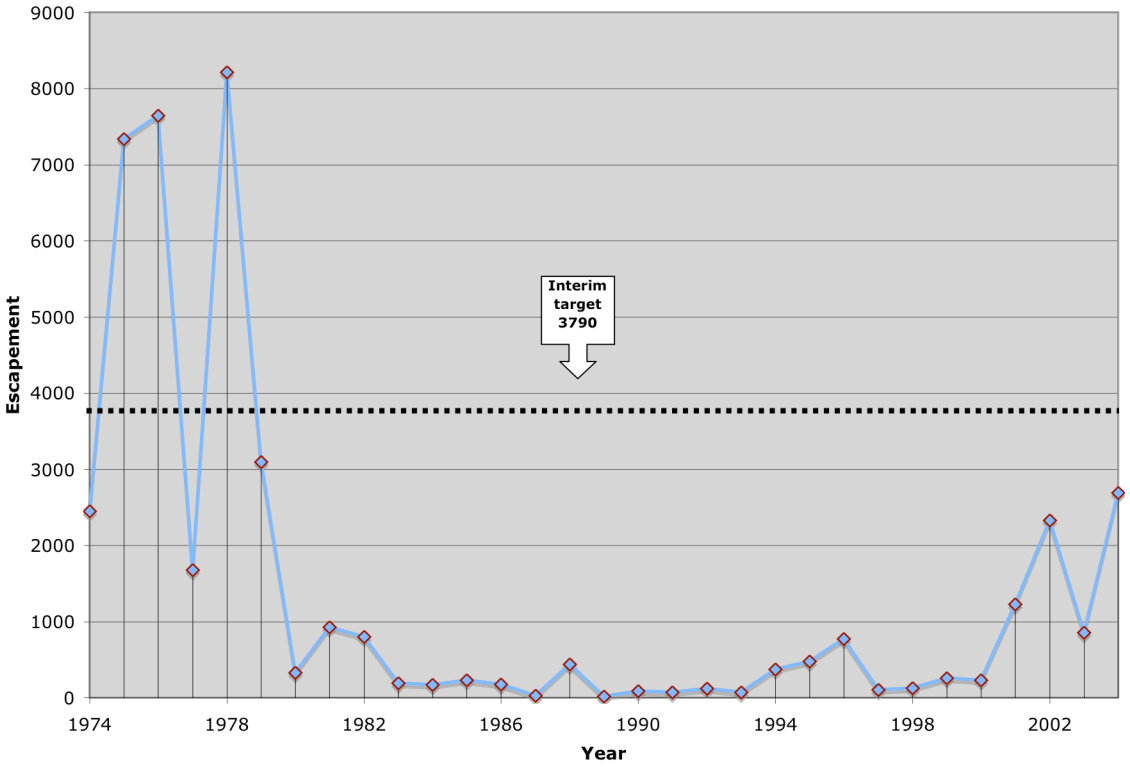

Figure 9.4. 1974-2003 summer chum salmon escapement for the Hama Hama River (data source: WDFW and PNPTT 2003, 2004, and 2005).

The co-managers have assessed the extinction risk faced by individual summer chum salmon stocks, based on the methodology offered by Allendorf, et. al. (1997) and discussed in detail in section 1.7.4 of the SCSCI (WDFW and PNPTT 2000). The extinction risk was assessed again in 2003, based on data available through 2002 (WDFW and PNPTT 2003). The most recent assessment of extinction risk from the co-managers for the Hama Hama stock states, "The annual average estimated Hama Hama system escapement over the past four years is 1,010 summer chum, ranging from 229 to 2,328 spawners. The effective population size (N_e) equals 727 fish for the 1999-02 return years, and total population size (N) is 3,636 for the same years. Because the population exceeds

the high risk abundance criterion (population size, N_e < 500 or N < 2,500) and is currently increasing relative to the low years from 1987-1993, the risk of extinction is judged to be low."[43]

Summer chum salmon escapement (number of adults returning to spawn) for the Duckabush River from the years 1974-2004 is presented in Figures 9.5.

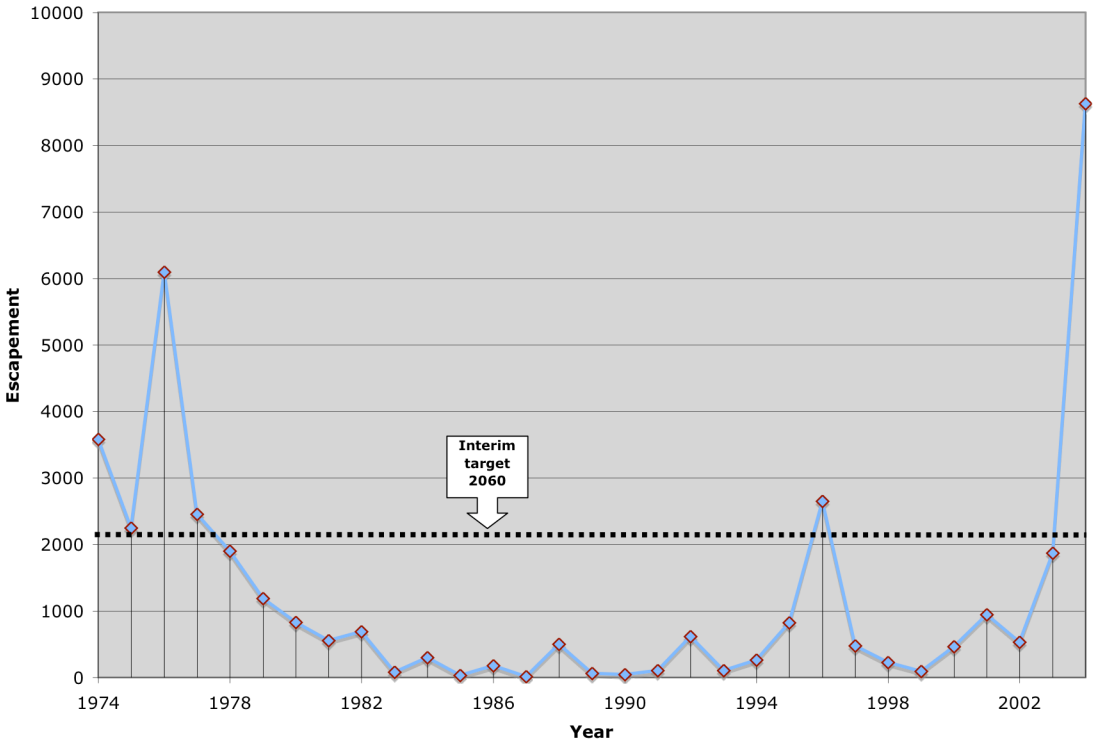

Figure 9.5. 1974-2003 summer chum salmon escapement for the Duckabush River (data source: WDFW and PNPTT 2003, 2004, and 2005).

The most recent assessment of extinction risk from the co-managers for the Duckabush stock says, "The estimated escapement to the Duckabush River ranges from 92 to 942 summer chum over the last four years, averaging 507 spawners. The effective population size (N_e) equals 365 fish for the 1999-02 return years, and total population size (N) is 1,825 for the same years. Though escapements have declined substantially since the 1970s, the current escapement levels are higher than the low levels experienced from 1984 through 1990. The recent population size for this stock (N_e < 500 or N < 2,500) indicates that the risk of extinction for Duckabush summer chum is moderate."[44]

[43] This assessment has just been updated by the co-managers and includes the years 2003 and 2004 (WDFW and PNPTT In preparation). The update indicates no change in the judgement of a low extinction risk for Hama Hama.
[44] It should be noted that the co-managers' extinction rate assessment for Duckabush has changed in a just updated assessment that includes the years 2003 and 2004. The update

Summer chum salmon escapement (number of adults returning to spawn) for the Dosewallips River from the years 1974-2004 is presented in Figures 9.6.

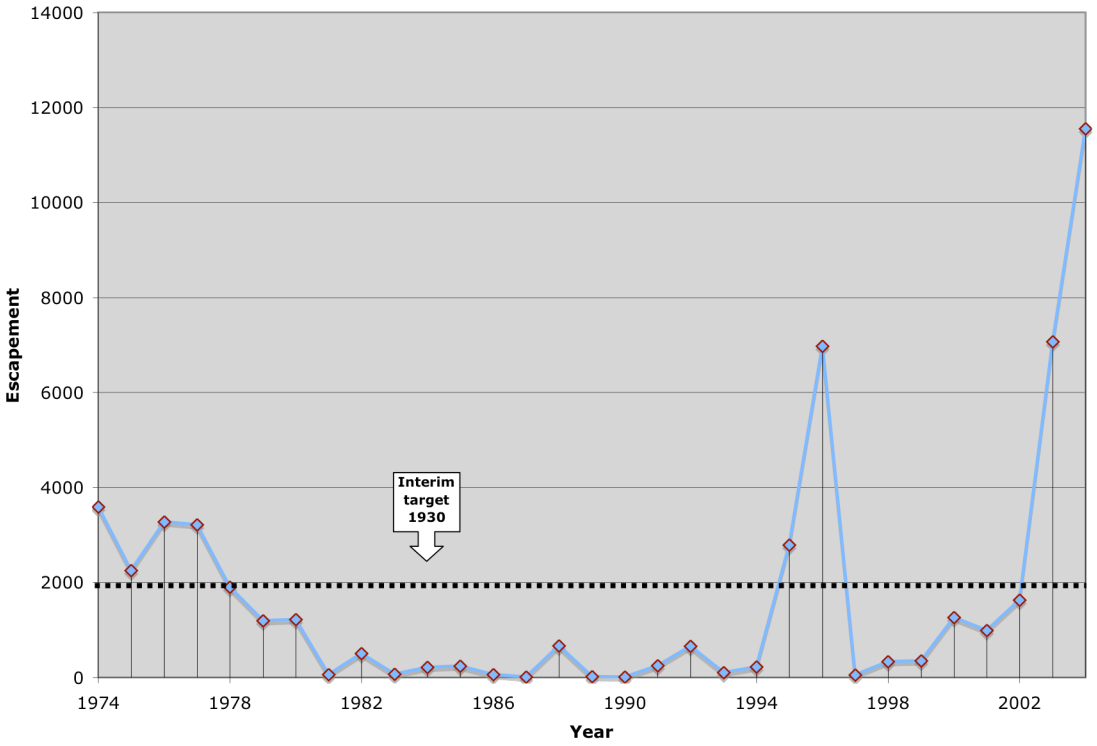

Figure 9.6. 1974-2003 summer chum salmon escapement for the Dosewallips River (data source: WDFW and PNPTT 2003, 2004, and 2005).

The most recent assessment of extinction risk from the co-managers for the Dosewallips stock states, "The 1999 through 2002 annual average escapement of summer chum salmon was 1,057 spawners, ranging from 47 to 1,260 fish. The effective population size (Ne) equals 761 fish for the 1999-02 return years, and total population size (N) is 3,805 for the same years. Escapements have increased substantially over the lows experienced in the 1980s and the recent population size for this stock exceeds the risk abundance criterion (Ne < 500 or N < 2,500), indicating that the current risk of extinction for Dosewallips summer chum is low."[45]

indicates the risk of extinction to now be low rather than moderate, owing primarily to the high escapements in 2003 and 2004 (WDFW and PNPTT In preparation).

[45] This assessment has been updated by the co-managers to include the years 2003 and 2004 (WDFW and PNPTT In preparation). The update indicates no change in the judgement of a low extinction risk for Dosewallips.

9.4. Habitat Overview & Environmental Conditions

Details of the EDT assessments for the Hama Hama-Duckabush-Dosewallips conservation unit stocks, including a summary of the baseline performance measures and a summary of strategic priorities, are provided in Appendix A. Other detailed assessments of habitat and environmental conditions are provided in the SCSCI (WDFW and PNPTT 2000), Correa (2003), and May and Peterson (2003).

9.4.1. Factors contributing to the decline of summer chum salmon

The populations in Hamma Hamma-Duckabush-Dosewallips conservation unit show a dramatic loss in performance, particularly in productivity. Under sustained, unfavorable ocean conditions, the population would be at a high risk of extinction (Lestelle et al 2005a). It should be noted that the results and conclusions of this EDT analysis for the Hamma Hamma watershed have not been fully reviewed by State, tribal and other biologists familiar with Hood Canal and the watershed. An understanding of the ecological importance of the connectivity of the lower river floodplain to the estuary and the effect of that connectivity on the function of the freshwater habitat in the lower river is critical for this type of assessment and will need to be further explored.

A summary of EDT conclusions for these populations (Lestelle, et. al., 2005a) states that:

• The populations shows a high loss in performance, compared to historic levels, both in abundance and productivity, particularly under unfavorable ocean survival conditions.

• The amount of potential increase in population abundance is greatest through restoration of freshwater reaches and connectivity with natal subestuary; full restoration of estuarine-marine waters and the natal subestuary appear to offer similar levels of benefit.

• Protection of freshwater reaches and a better understanding of the connectivity with the natal subestuary is the highest priority.

• Potential benefits of restoring estuarine-marine areas are diffused over many segments.

• Within freshwater, habitat diversity, channel stability, and sediment load are seen as the most important factors to restore.

• Within the natal subestuary, several factors appear to be equally important for restoration, along with the amount of area available to be used for rearing.

• Within the estuarine-marine environment, the most important factor for restoration is food, associated with loss of eelgrass, the installation of revetments, and loss of riparian corridors.

The SCSCI (WDFW and PNPTT 2000), the "Limiting Factors Report for WRIA 17" prepared by the Washington Conservation Commission (Correa 2003), and May and Peterson (2003) provide details of the various habitat factors and environmental conditions affecting summer chum salmon in this conservation unit. In general, the findings from these reports are corroborated by the EDT assessment (Appendix A). These factors and conditions are summarized in the tables below for the Hama Hama River (Table 9.3), for the Duckabush River (Table 9.4), and for the Dosewallips River (Table 9.5).

Table 9.3. Hama Hama River

Factors for decline	Life stage most affected	Remarks
Loss of channel complexity (large woody debris, channel condition, loss of side channel, channel instability)	Spawning and incubation	In lower mainstem, dredging and bank hardening along with removal of large woody debris has reduced overall channel complexity. Large woody debris is completely lacking in specifically identified areas.
Altered sediment dynamics	Spawning and incubation	Extensive sediment aggradation in lower John Creek has impeded spawning access in recent years. Subsurface flows can occur in summer during spawning migration periods, which robs spawners of needed flow.
Riparian degradation	Spawning and incubation	48% of the forested buffer area consists of small trees (<12 in dbh). In the lower 1.8 miles of John Creek, pools composed 51% of the total habitat area (rated fair), but large woody debris loading was extremely poor (0.06 large woody debris pieces/m). Most notably, large-sized large woody debris pieces, which are important habitat forming and stabilizing features of larger rivers, were completely absent from the Hama Hama mainstem, suggesting that streambed instability that may result in redd scour during peak flow events.
Estuarine habitat loss and degradation (diking, filling, log storage, road causeways)	Juvenile rearing and migration	Over 13% of the estimated 368.5 acre historic delta is diked in three areas, accounting for a loss of summer chum rearing habitat. One filled area in the

		outer, southern corner of the delta accounts for a loss of 3.2 acres (1% of historic delta habitat). An estimated 2.4 acres (0.6% of historic delta area) of the mainstem distributary channel, where it crosses the outer intertidal area, has been dredged. At least seven areas of aquaculture or other modifications of the delta surface are apparent from contemporary aerial photographs that total 2.2 acres (0.6% of historic delta area).

Table 9.4. Duckabush River

Factors for decline	Life stage most affected	Remarks
Loss of channel complexity (large woody debris, channel condition, loss of side channel, channel instability) and floodplain loss	Spawning and incubation	The channel in the lower river appears to have been greatly simplified since the late 1800s by the scouring action of splash damming, large woody debris removal, and conversion of floodplain to pastureland and residential development. As a result, habitat diversity and complexity has been reduced (e.g. side channels, deep holding pools, and stable spawning gravels). A 1992 U.S. Fish and Wildlife Service survey from river mile 0.2 to 2.3 found 31% of habitat area in pools and sparse woody debris, which indicates degraded habitat conditions.
Sediment aggradation	Spawning and incubation	Channelized and diked area in the lower reaches has resulted in channel aggradation. Forest Service logging roads built during the 1940s to 1960s contribute to the sedimentation problems.

Loss of riparian forest	Spawning and incubation	Logging of old growth floodplain forest and conversion to pasture and residential areas has greatly reduced the potential for large woody debris recruitment to the channel. The forested buffer below river mile 3.0 is dominated by medium-sized (12-20 in dbh) trees (66%) and, to a lesser extent, small (<12 in dbh) trees (32%). Mixed conifer and deciduous forests predominate (57%) in the riparian zone, and 59% of the forested buffer is >132 ft in width (all percentages by length).
Estuarine habitat loss and degradation (diking, filling, log storage, road causeways)	Juvenile rearing and migration	Two diked areas totaling 3.9 acres occupy 2.8% of the original 291.6 acres of estuarine delta habitat; these diked areas are located at the northern edge of the delta and are association with residential development adjacent to a small distributary channel. An estimated 0.2 acres (0.1%) of the historic delta area has been filled and two ditches or remnant dikes with a total length of 0.3 mi are evident in the delta. US Highway 101 is the most prominent of five roads that traverse the delta.

Table 9.5. Dosewallips River

Factors for decline	Life stage most affected	Remarks
Loss of channel complexity (large woody debris, channel condition, loss of side channel, channel instability) and floodplain loss	Spawning and incubation	Much of the lower river below river mile 3.0 has been simplified since the late 1800s by the placement of riprap, dike construction, large woody debris removal, the scouring action of splash dam operation, and conversion of floodplain to pastureland and residential development.
Sediment aggradation	Spawning and incubation	Channelized and diked area in the lower reaches has resulted in channel aggradation. Forest Service logging roads built during the 1940s to 1960s contribute to the sediment problems.
Loss of riparian forest	Spawning and incubation	Logging of old-growth floodplain forest areas along the lower 3.0 miles of the river has reduced both the original extent of riparian forests and the potential for large woody debris recruitment to the channel. Small trees (<12 in dbh) dominate 51% of the forested buffer below river mile 4.3. Forty one percent is deciduous dominated, but 52% is mixed conifer and deciduous forest and 58% of the forested buffer is greater than 132 ft wide (all percentages by length). An analysis of riparian large woody debris recruitment potential completed by the US Forest Service as part of the Dosewallips Watershed Analysis also identified fair (28%, by stream length) to poor (40%) riparian conditions predominating along the

		entire length of the river mainstem.
Estuarine habitat loss and degradation (diking, filling, log storage, road causeways)	Juvenile rearing and migration	15.4% (68.5 ac) of the original summer chum rearing and migration habitat area in the Dosewallips estuary is diked. Four tidegates appear to regulate or prevent tidal inundation in these diked areas. One ditch or remnant dike, 0.4 mi long, attests to past attempts to further eliminate tidal inundation along the delta face. Ten road causeways, totaling 1.2 mi, bisect or fringe the delta. The Highway 101 crossing of the delta is the most deleterious. Construction of the highway, and the subsequent development that was facilitated by it, essentially cut off most of the secondary tidal channel connectivity across the delta. Two major distributary channels, that appear to have historically linked with the river higher in the delta, were isolated. Five identifiable fill areas associated with residential or agricultural development occupy 2.5 ac (0.6% of historical delta area). One aquaculture or similar modification to the delta surface covers 2.9 ac (0.6%), but it is not evident whether this poses a significant loss of estuarine habitat function. That loss depends to a large degree on the scale and frequency of disturbance to important habitat areas such as eelgrass.

9.4.2. Human development and land use

Population density in the Hama Hama-Duckabush-Dosewallips Conservation Unit is relatively low. Figure 9.7 Presents population density for the watersheds in the conservation unit.

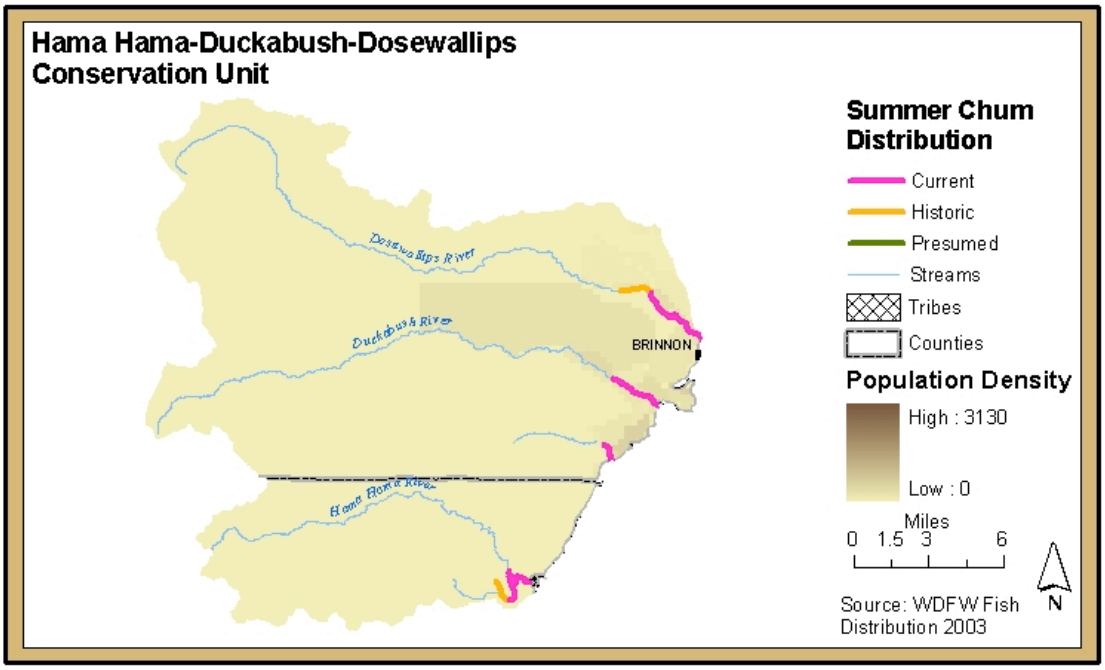

Figure 9.7. Human population density (people per square mile) for the Hama Hama, Duckabush, and Dosewallips River watersheds (map produced by Gretchen Peterson, Peterson GIS).

A total of an additional 125 people are expected in the Dosewallips and Duckabush watersheds over the next twenty years (Christensen 2003). Table 9.6 presents the results of population projections and growth rates.

Table 9.6. Population projections and growth rates for the Dosewallips and Duckabush watersheds (from Christensen 2003).

Watershed	Population in 2000	20 Year Estimated Population Growth	2024 Estimated Population	Notes
Dosewallips River	284	56	340	Rural Growth Rate assumed 1.09%
Duckabush River	350	69	419	Rural Growth Rate assumed 1.09%

The Hama Hama River originates on the rugged eastern slope of the Olympic Mountains within the Olympic National Park and enters Hood Canal in northern Mason County, south of the rural community of Eldon. Nearly 95% of the Hama Hama watershed is under public ownership; 60% is managed public forestland

and 34% is protected in National Park or designated wilderness. The remaining 5% is under private ownership and is located in the lower portions of the watershed. Most of the floodplain area along the lower 1.5 miles of the Hama Hama has been appropriated for agricultural and residential uses (WDFW and PNPTT 2000). The main channel today was a secondary channel historically. It has been straightened, channelized, diked and dredged. The freshwater flow has been routed away from present shellfish beds. The historic secondary channel, now the mainstem, was once an extended salt marsh with a spit crossing the mainstem. Pilings were placed on the spit itself to support a dike, which has now eroded away. A large bulkhead and fill now accommodates a shellfish facility at the base of the historic spit (Correa 2003).

Mason County has designated the lands in the lower Hama Hama as Agricultural Resource Lands or Rural Residential (RR5-one dwelling unit per 5 acres) according to Mason County Resource Ordinance 77-93, adopted January 2005 (Mason County Code 17.01). The Mason County Resource Ordinance is in effect while the Mason County Comprehensive Plan is being reviewed for revision according to the mandates of GMA. Figure 9.8 presents land ownership, and associated summer chum distribution, for the Hama Hama watershed.

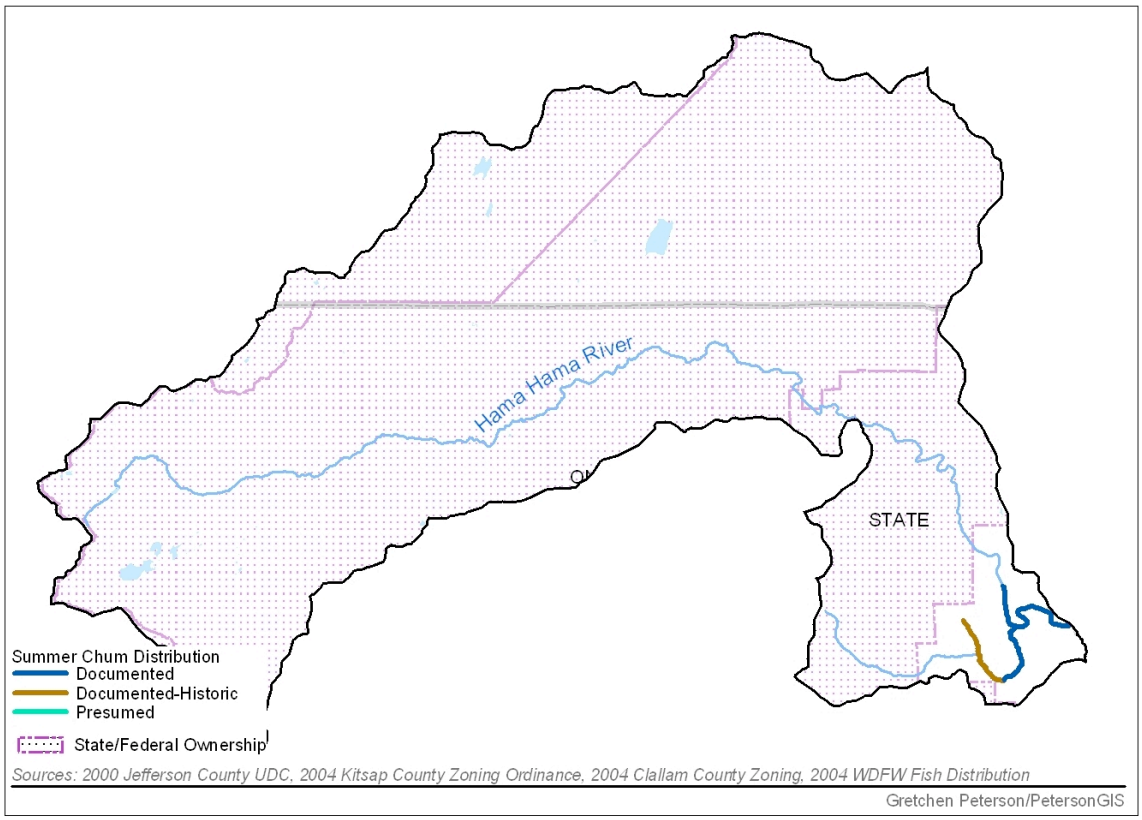

Figure 9.8. Land use and ownership for the Hama Hama watershed.

The upper 80% of the Duckabush River watershed is protected in Olympic National Park and the Brothers Wilderness in the Olympic National Forest. Nearly 25% of the riparian zone below river mile (RM) 3 is now developed (12% urban/commercial, 9% rural residences, and 3% roads/dikes). US Forest Service ownership begins at approximately RM 2.3 and extends upstream to approximately RM 11.5. Between the USFS lands and the mouth of the river, land use is predominantly managed for timber harvest, with some rural residential and urban commercial development in the lower 1.5 miles (Correa 2003). Figure 9.9 depicts land use for the Duckabush watershed according to the Jefferson County UDC Title 18.

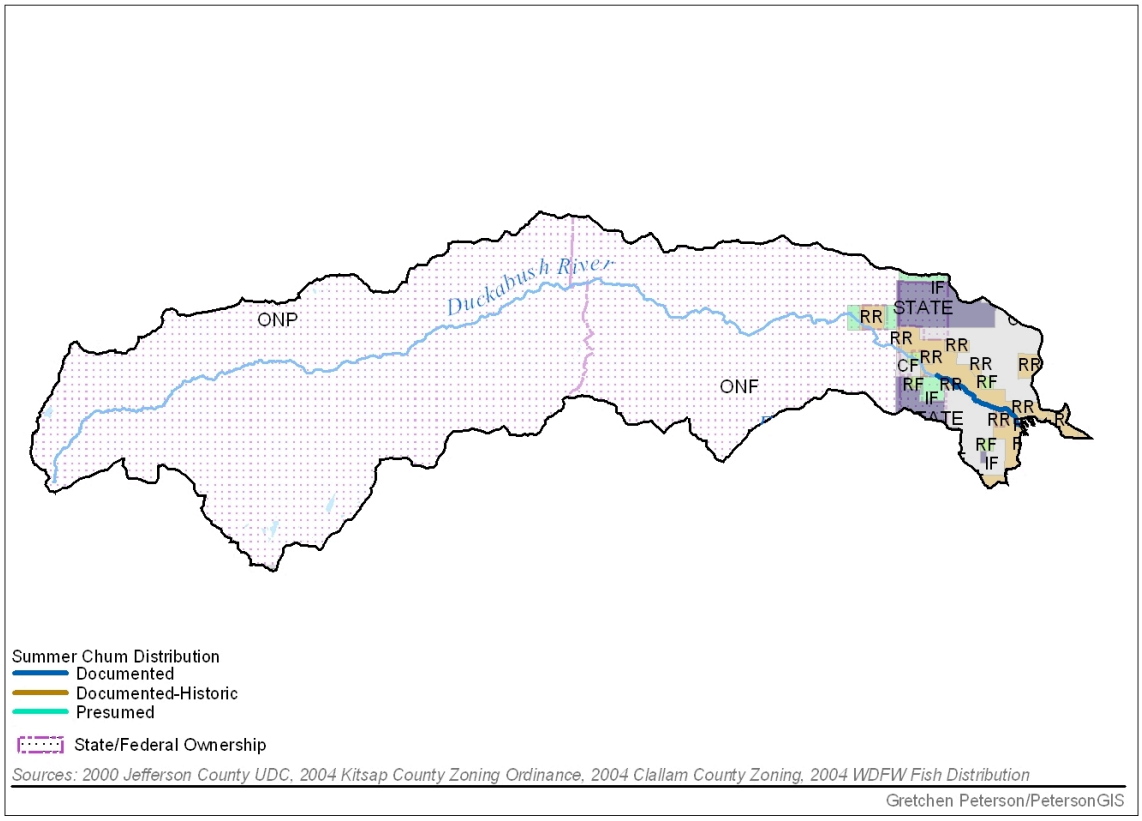

Figure 9.9. Land use for the Duckabush watershed from the Jefferson County UDC Title 18.

Downstream of the federal lands, the Duckabush flows through areas zoned as either Rural Residential (RR 1:5) or Commercial Forest (CF). Rural Residential 1 Unit/5 Acres (RR 1:5) areas "allow for continued residential development in areas of Jefferson County consisting of relatively high density pre-existing patterns of development, along the county's coastal areas, and within areas within or adjacent to rural centers and rural crossroads. In addition, this district seeks to support and foster Jefferson County's existing rural residential landscape and character by restricting new land divisions to a base density of one unit per five acres." Commercial Forest (CF) lands are designated to "ensure large tracts of

forest lands of long-term significance are protected from incompatible uses thereby sustaining the ability of forest resource extraction activities to be maintained as a viable commercial activity." Figure 9.10 shows the lower approximately 1 mile of the Duckabush and the designated land use.

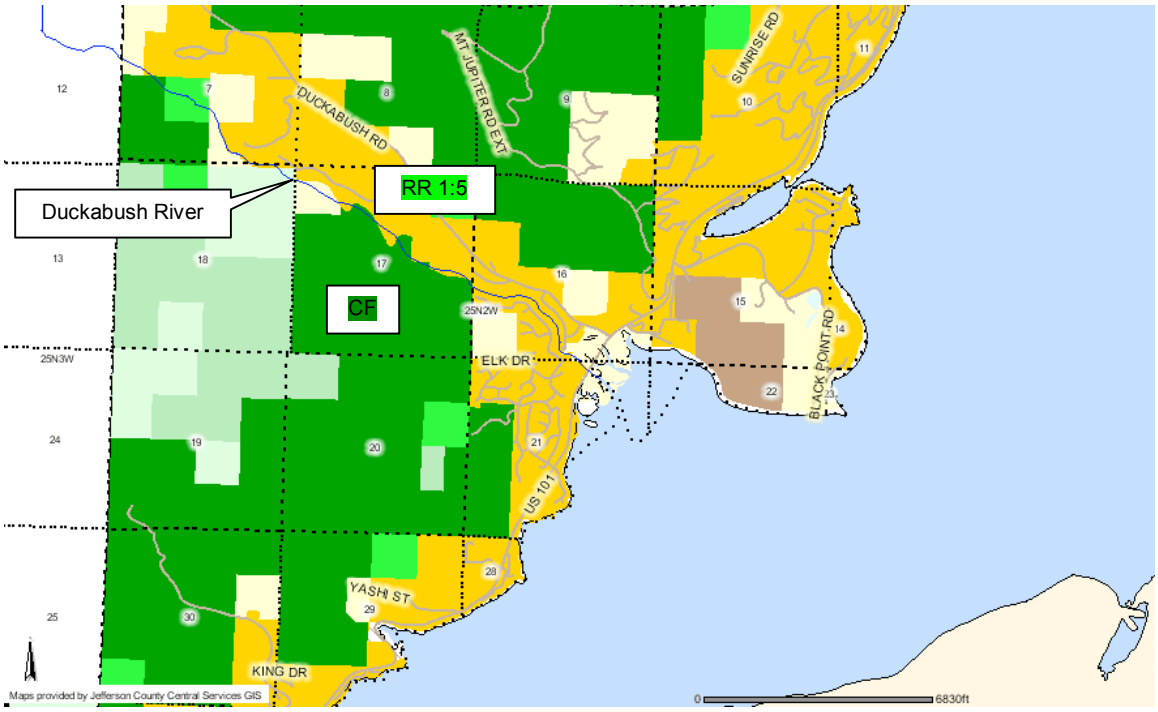

Figure 9.10. Land use designations for the lower portion of the Duckabush River (http://www.co.jefferson.wa.us/idms/mapserver.shtml).

The upper 60% of the Dosewallips watershed is undeveloped and protected within Olympic National Park, while the middle 30% of the basin is in the Olympic National Forest. As with other west Hood Canal watersheds, private land is concentrated along sensitive lower reaches of the river, where use is dominated by pastureland, residential development, and clearcut logging. Dosewallips State Park occupies land on the south side of the river near the mouth, and the town of Brinnon is located to the north, within the floodplain delta area (WDFW and PNPTT 2000). Outside of the Federal lands the river flows through land use designations of Rural Residential Agricultural Lands and Commercial Forest lands.

Figure 9.11 presents the land use for the Dosewallips watershed as designated by Jefferson County's UDC Title 18.

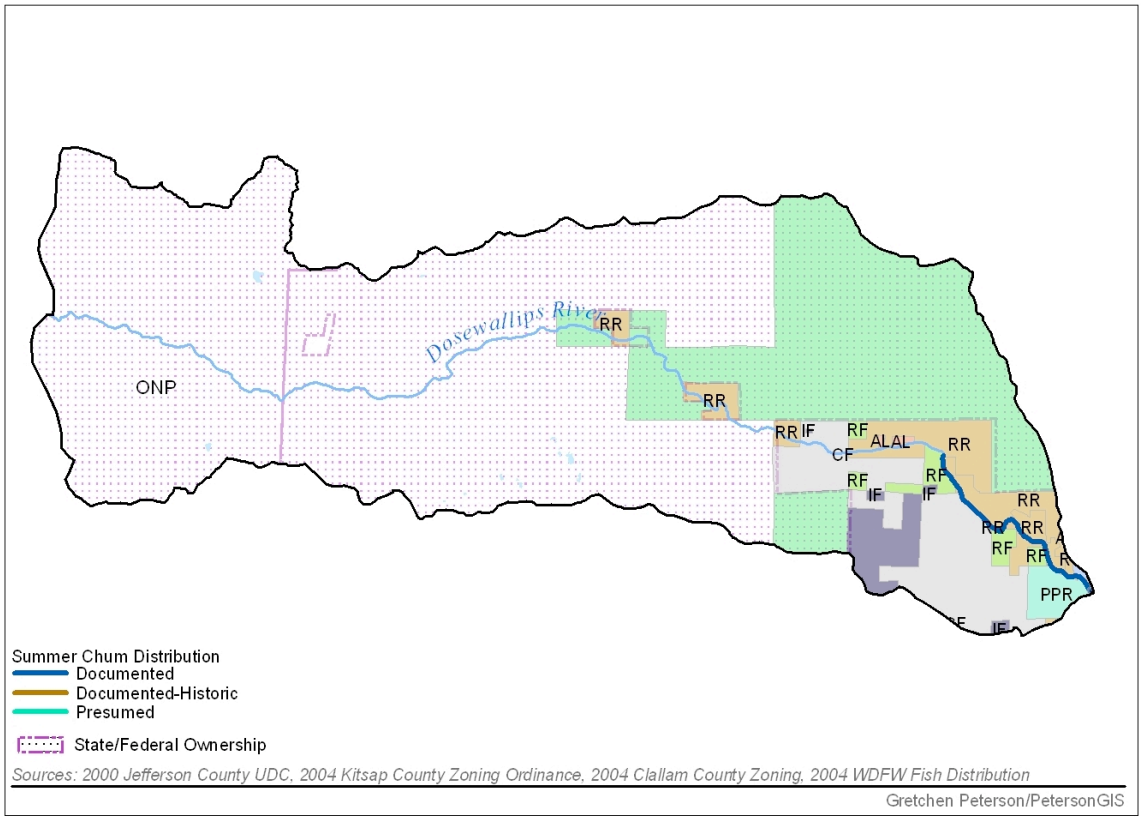

Figure 9.11. Land use designated for the Dosewallips River watershed from Jefferson County UDC title 18.

The town of Brinnon sits at the mouth of the Dosewallips River where it is zoned as a Rural Village Center (RVC). According to Jefferson County Unified Development Code Title 18, Rural Village Centers "provide for most of the essential needs of the surrounding rural population and the traveling public. These areas supply a variety of basic goods and day-to-day services, while also providing a limited range of professional, public and social services. They are typically small, unincorporated commercial and residential community centers that provide rural levels of service and serve as a focal point for the local population. The boundaries of the rural village centers are predominantly defined by the contained, built environment as it existed in 1990 or before, as required by RCW 36.70A.070(5)(d)." Designated rural village centers for Jefferson County include Quilcene and Brinnon. Also at the mouth of the Dosewallips River is a State Park.

Figure 9.12 presents the land use designations for the lower Dosewallips River basin.

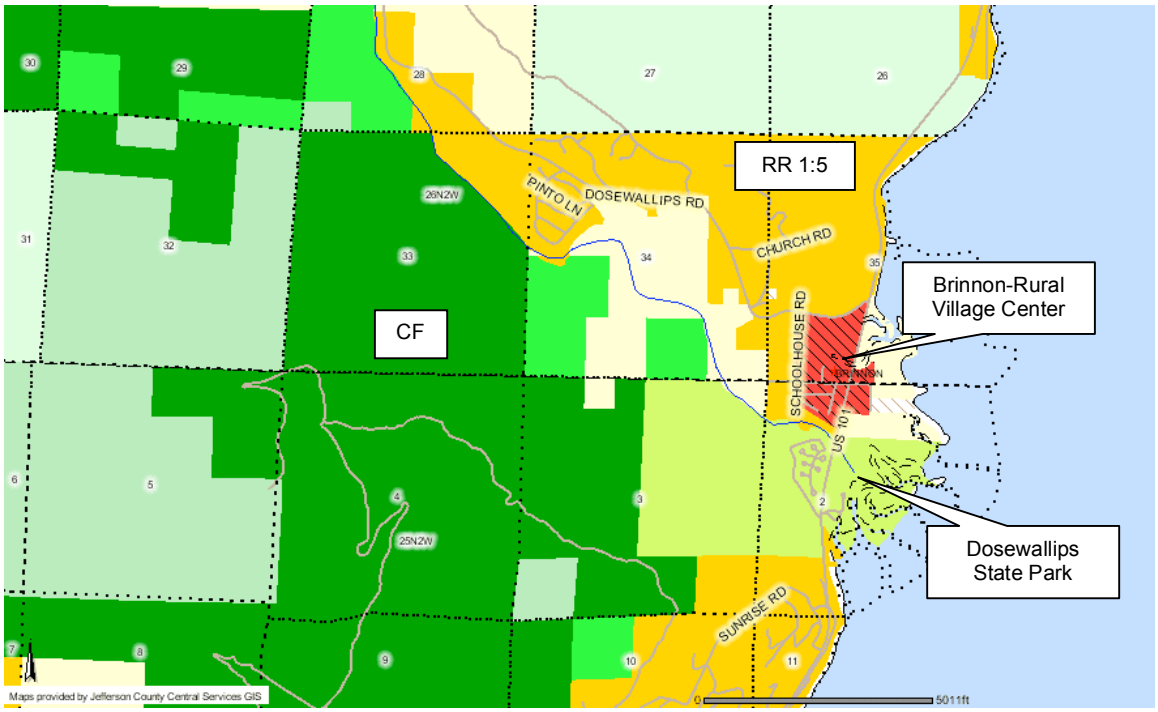

Figure 9.12. Land use and zoning for the lower Dosewallips River (http://www.co.jefferson.wa.us/idms/mapserver.shtml).

Rural Residential 1 Unit/5 Acres (RR 1:5) areas "allow for continued residential development in areas of Jefferson County consisting of relatively high density pre-existing patterns of development, along the county's coastal areas, and within areas within or adjacent to rural centers and rural crossroads. In addition, this district seeks to support and foster Jefferson County's existing rural residential landscape and character by restricting new land divisions to a base density of one unit per five acres." Commercial Forest (CF-80) lands are designated to "ensure large tracts of forest lands of long-term significance are protected from incompatible uses thereby sustaining the ability of forest resource extraction activities to be maintained as a viable commercial activity."

Understanding future population growth, and its associated development, is critical to determine the potential future impacts to summer chum salmon habitat. A build-out analysis was conducted for the summer chum salmon ESU geographic area. This analysis used impervious surface area as a proxy for development. Based on existing land use designations (which are unique to each individual County), future impervious surface area was calculated and modeled. The amount of additional impervious surface area (relative to current), and where it can be expected to occur, was determined for each County. Appendix C provides details of the methods used to conduct these build-out analyses.

Current and projected development, in the Duckabush and Dosewallips watersheds, was analyzed (Peterson 2005, see Appendix C). Riparian corridors were delineated from 200 feet on either side of the river from the mouth upstream to the extent of presumed summer chum salmon distribution. Impervious surface area (IP) was measured using 5-meter resolution satellite imagery. Current IP within the Duckabush riparian corridor is 5.8% of the total riparian corridor area. For the Dosewallips corridor this value is 4.9%. Build-out looked at the potential to develop the land under current regulatory programs and land use. Build-out for the Duckabush corridor is projected at 9.6% of the total area or an additional 4.4 acres of IP. For the Dosewallips corridor the additional acres of IP under build-out is projected to be 3.6 for a total of 7.0% of the corridor. These results are summarized in Table 9.7.

Table 9.7. Current impervious area (IP) and modeled build-out for the Duckabush and Dosewallips riparian corridors.

Riparian Corridor	Corridor area acres	Current IP acres	Build-out IP acres	Added IP acres	Current IP%	Build-out IP%
Duckabush River	114	6.5	10.9	4.4	5.8	9.6
Dosewallips River	166	8.1	11.7	3.6	4.9	7.0

The uplands and nearshore, within one mile of the Duckabush and Dosewallips subestuaries, were also analyzed for projected build-out (Peterson 2005). Of the total area delineated in the Duckabush subestuary zone, current IP is at 4.0%. After build-out the IP climbs to 5.3% for a total of 6.7 additional acres within the delineated subestuarine zone. For the Dosewallips subestuary, the total acres of current IP in the subestuary is 21. Under build-out, 3.5 acres of IP will be added to comprise 4.1% of the subestuarine area analyzed. The results of this analysis are summarized in Table 9.8.

Table 9.8. Current impervious area (IP) and modeled build-out for the subestuaries of the Duckabush and Dosewallips Rivers.

Estuary	Estuary Acres	Current IP acres	Build-out IP acres	Added IP acres	Current IP%	Build-out IP%
Duckabush	464	23.5	30.2	6.7	4.0	5.3
Dosewallips	620	20.8	24.3	3.5	2.9	4.1

Watershed and stream research, which typically looks at a watershed-wide perspective, generally indicates that certain zones of stream quality exist. Most notably, at about 10% impervious cover area, sensitive stream elements are lost from the system. A second threshold appears to exist at around 25 to 30% impervious area, where most indicators of stream quality consistently shift to a poor condition (e.g., diminished aquatic diversity, water quality, and habitat

scores).[46] More research is needed to determine if this research directly applies to the present analysis. It should be noted that similar research, however, has not been conducted for estuary and subestuary areas.

9.5. Specific action recommendations

Section 9.5 presents specific recovery action recommendations for the Hama Hama-Duckabush-Dosewallips conservation unit. Recommended actions are categorized as either Programmatic (section 9.5.1) or Project (section 9.5.2). Actions identified will be further delineated as actions to benefit the targeted spawning aggregations (Hama Hama, Duckabush, Dosewallips). Specific action recommendations are also summarized and analyzed in the context of overall ESU-wide recovery (see section 13). All actions (previously implemented, on-going, and proposed) will become part of the Monitoring and Adaptive Management Program for the SRP as described in section 14.

9.5.1. Programmatic recommendations

Programmatic recovery actions are those that are part of a policy, program, or process. They are generally of a regulatory or planning process nature. Programmatic actions could be part of a County's land use and regulatory program and structures or watershed planning processes. Comprehensive plans, critical areas ordinances, shoreline management master programs, and zoning could all be considered programmatic actions in this context. Programmatic actions are non-project (i.e., habitat restoration projects--LWD placement, culvert repairs, etc.) in nature. Programmatic actions, however, can include projects when such projects are descriptive of a comprehensive or encompassing process (i.e., levee removal or set back as part of an estuary restoration plan). Watershed management plans often include projects to address identified factors of decline or specific habitat conditions. For the purposes of this SRP, the management plans or planning processes will be considered programmatic actions whereas the projects identified within the management plans will be categorized as projects.

[46] See The Center for Watershed Protection's (http://www.cwp.org) Stormwater Manager Resource Center at http://www.stormwatercenter.net for more extensive references on this subject. Table 1 at http://www.stormwatercenter.net/monitoring and assessment/imp cover/impercovr model.htm reviews the key findings of recent research regarding the impacts of urbanization on aquatic systems.

To most effectively address those factors that are likely affecting the performance of the spawning aggregations in this conservation unit, the SRP recommends the programmatic actions summarized in Table 9.9. Details of the programmatic actions approved and those being considered by the Jefferson County and Mason County Boards of County Commissioners can be found in section 13.

Table 9.9. SRP recommended programmatic actions for the spawning aggregations in the Hama Hama-Duckabush-Dosewallips conservation unit.

Recommended Programmatic Actions	Actions involved	Limiting factors to address
Jefferson County zoning for the Duckabush and Dosewallips watersheds	-support continuation of the present zoning for the upper watersheds -monitor long-term effectiveness of the zoning code and enforcement -support Staff on their efforts regarding the core habitats and corridors work including development within channel migration zones -adopt CMZ guidelines as proposed for the CAO update (see section 13-"Jefferson County Programmatic Actions" for more details)	-poor riparian condition -loss of channel complexity (LWD, channel condition, loss of side channel, channel instability)
Dosewallips River comprehensive floodplain management plan	-develop a comprehensive floodplain management plan consistent with summer chum salmon recovery involving the Brinnon community and Dosewallips State Park (see section 13-"Jefferson County Programmatic Actions" for more details)	-poor riparian condition -loss of channel complexity (LWD, channel condition, loss of side channel, channel
Olympic National Forest and State lands	-continue to preserve these lands in current ownership -Forest Service road maintenance and road abandonment plans should be implemented including appropriate resources to effectively complete the projects	-sediment aggradation
Community Nearshore Restoration Program	-pursue application and implementation of a Community Nearshore Restoration program similar to that being conducted in south Hood Canal (see section 13)	-estuarine and nearshore habitat loss and degradation

Comprehensive floodplain management and restoration plan for the Lower Hama Hama watershed	-a floodplain management and restoration plan would have to be developed with the current landowner to determine feasibility of protecting and restoring summer chum salmon habitat while maintain the economic viability of the current shellfish industry being conducted in the estuary. -the SRP recommends working with the landowners, Mason County, WSDOT, federal highway agencies, and co-managers in the development of the SRP and options to consider.	-poor riparian condition -loss of channel complexity (LWD, channel condition, loss of side channel, channel -estuarine and nearshore habitat loss and degradation
Hama Hama River Summer Chum Salmon Supplementation Project	-continue the supplementation project to ensure appropriate and properly funding monitoring occurs. -see section 14 of this SRP	-see WDFW and PNPTT (2000) and (2003a) for complete details of this project, also section 5 of this SRP

9.5.2. Project recommendations

Project recovery actions are generally physical modifications to the landscape designed to address specific habitat situations in specific and limited geographic areas. Projects in the summer chum salmon ESU have been in process for many years by a variety of groups and entities. Section 9.5.2.1 provides an overview of existing projects relative to summer chum salmon recovery planning. Many of the project recommendations presented in this SRP are from the HCCC Lead Entity strategy (HCCC 2004). This SRP is designed to coordinate with, and build on that strategy. Projects presented are categorized according to their benefit for the spawning aggregation of concern (Hama Hama, Duckabush, Dosewallips spawning aggregations). All projects that are proposed or recommended in this SRP are strictly voluntary in nature. Those projects that would either take place on, or impact, private property will require the full cooperation and permission from the affected landowners before proceeding. If that landowner permission cannot be obtained, those projects will not proceed.

9.5.2.1. Existing Projects

Figure 9.13 shows the lower Hama Hama watershed. Shading denotes protected lands.

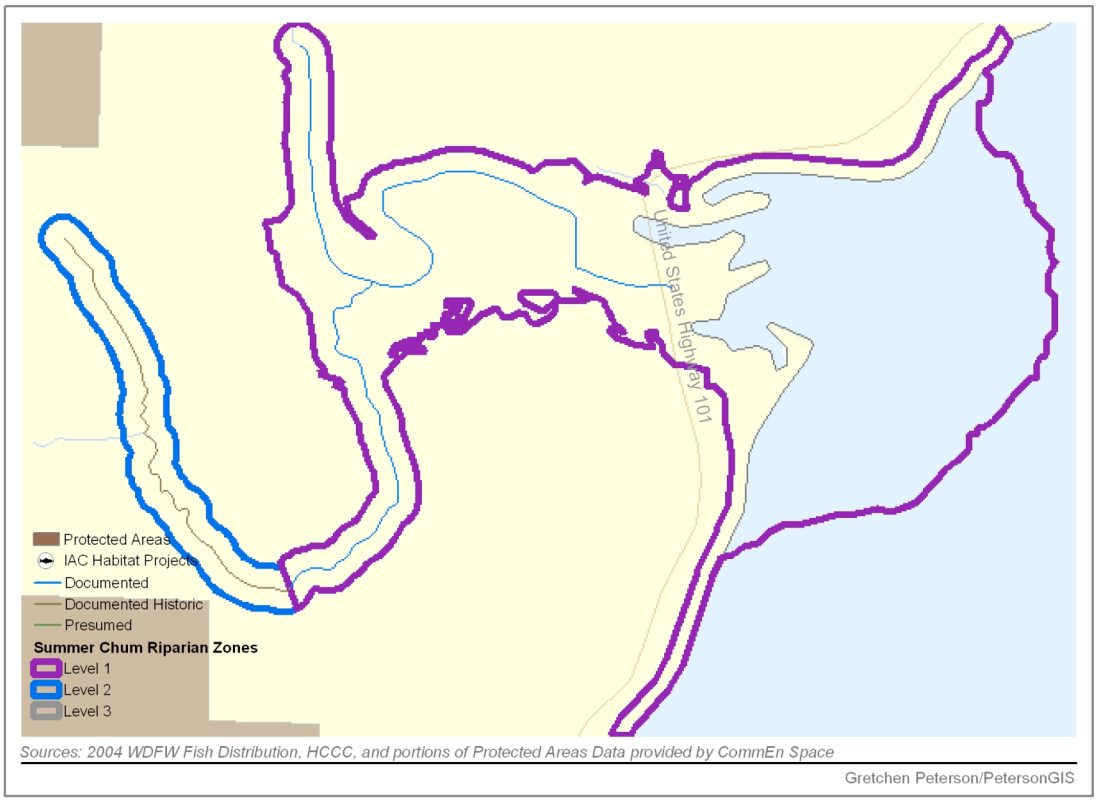

Figure 9.13. The lower Hama Hama watershed. Shaded areas on the map are protected areas near the lower Hama Hama watershed.

No existing summer chum salmon recovery projects are in process nor completed in the Hama Hama watershed. A supplementation program for summer chum salmon is underway and described in section 5 of the SRP.

Figure 9.14 shows the lower Duckabush watershed. Protected lands are denoted by shading. No existing summer chum salmon recovery projects are in process nor completed in the Duckabush watershed.

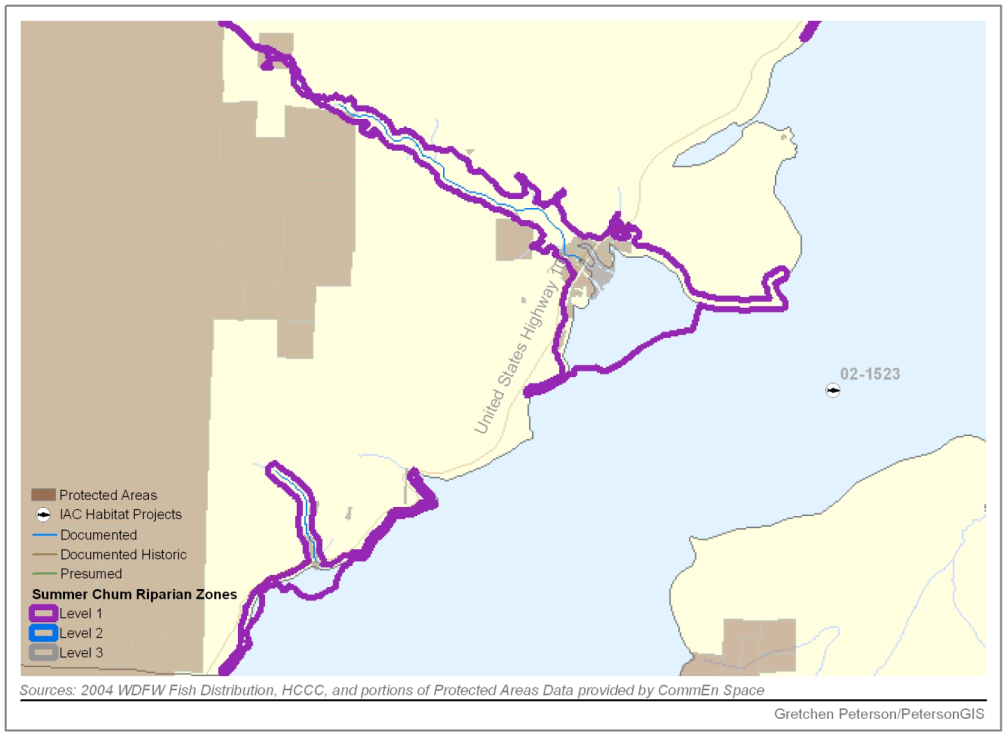

Figure 9.14. The lower Duckabush watershed showing protected areas (shaded areas on map).

Figure 9.15 shows the lower Dosewallips watershed. Protected lands are denoted by shading.

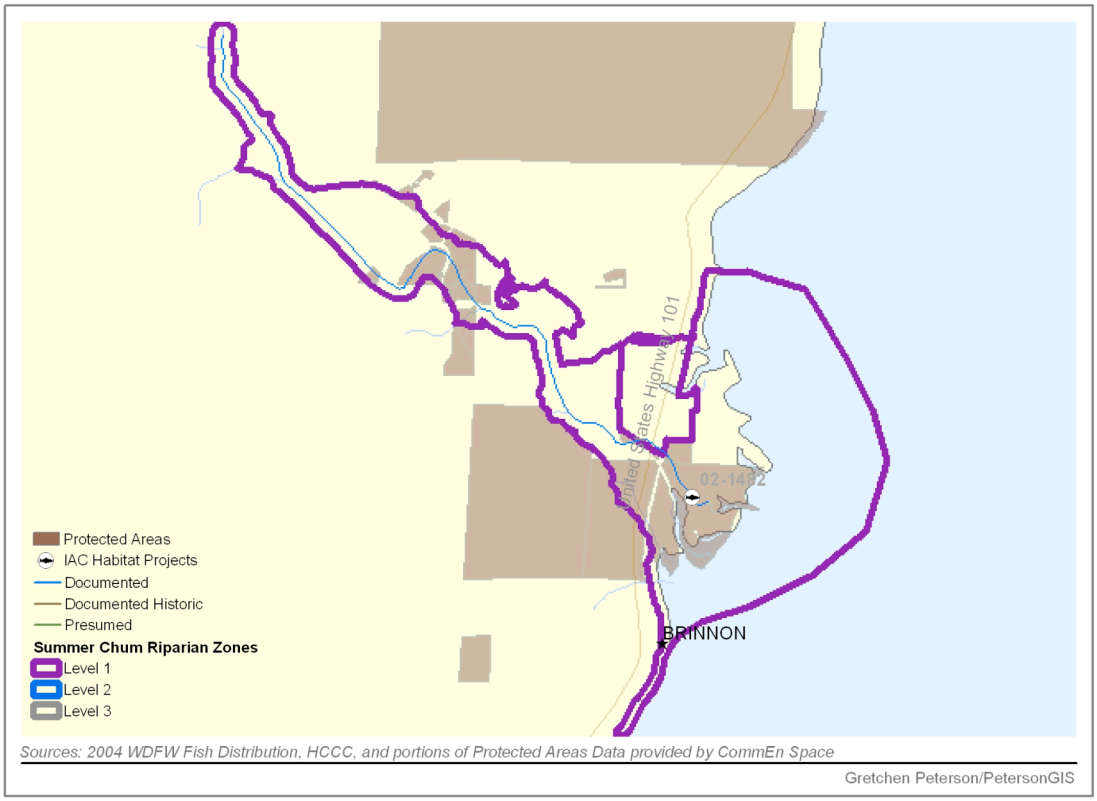

Figure 9.15. The lower Dosewallips watershed.

The existing summer chum salmon recovery project for the Dosewallips watershed is described below (project descriptions are derived from IAC Grant Projects at http://www.iac.wa.gov/maps/default.asp and click on the Grant Project Maps link, accessed on June 14, 2005):

02-1482 Dosewallips Estuary Restoration Phase 1, Project Description: This project will perform a variety of estuarine restoration measures at the Dosewallips estuary. Phase 1 work targets publicly owned lands held by WA State Parks and key privately owned lands, which constitute most of the tidally influenced environment of the lower river. The project will include project identification, prioritization, design, implementation, and monitoring measures. Phase 1 will include distributary slough and estuarine marsh restoration.

9.5.2.2. Project Recommendations for the Hama Hama, Duckabush, and Dosewallips Spawning Aggregations

To most effectively address those factors that are likely affecting the performance of the Hama Hama, Duckabush, and Dosewallips spawning aggregations, the SRP recommends the following projects. All projects that are proposed or recommended in this SRP are strictly voluntary in nature. Those projects that would either take place on, or impact, private property will require the full cooperation and permission from the affected landowners before proceeding. If that landowner permission cannot be obtained, those projects will not proceed. Estimated costs for these projects is presented in Appendix D.

Table 9.10. SRP recommended projects for the Hama Hama spawning aggregation.

Hama Hama

Project/Action	Tasks involved, sub-actions, barriers to implementation	Limiting factors to address
Consider a lower channel subestuary plan working with landowner to restore mainstem channel complexity, tidal channels, and estuary function by potentially breaching or removing levees/dikes and armoring, particularly mainstem dike, the dike along the north side of the estuary, and other minor dikes	-an important shellfish industry currently exists at the mouth of the Hama Hama River. A restoration plan would have to be developed with the current landowner to determine feasibility (see programmatic recommendations above in Table 9.9)	-poor riparian condition -loss of channel complexity (LWD, channel condition, loss of side channel, channel -estuarine and nearshore habitat loss and degradation
Relocate US101 to the west, acquire historic estuarine properties, and restore Jorsted Creek estuary	-would need to be a part of the comprehensive floodplain management plan discussed in the item above. -would need to involve WSDOT and Federal highway agencies	-estuarine and nearshore habitat loss and degradation
Replace US101 causeway/bridge with an elevated structure across the entire delta	-would need to be a part of the comprehensive floodplain management plan discuss in the item above. -would need to involve WSDOT and Federal highway agencies	-poor riparian condition -loss of channel complexity (LWD, channel condition, loss of side channel, channel -Estuarine and nearshore habitat loss and degradation
Remove fill and relocate structures along north side of Wacketickeh estuary	-would need to be a part of the comprehensive floodplain management plan discuss in the item above. -would need to involve WSDOT and Federal highway agencies	-estuarine and nearshore habitat loss and degradation

Remove bulkhead and fill that forms an unused part of a parking lot to the north of shellfish facility to restore salt marsh habitat	-would need to be a part of the comprehensive floodplain management plan discuss in the item above. -would need to involve WSDOT and Federal highway agencies	-estuarine and nearshore habitat loss and degradation
Remove creosote pilings to the north of Jorsted Creek	-work with State to determine feasibility	-estuarine and nearshore habitat loss and degradation

To most effectively address those factors that are likely affecting the performance of the Duckabush spawning aggregation, the SRP recommends the projects summarized in Table 9.11.

Table 9.11. SRP recommended projects for the Duckabush spawning aggregation.

Duckabush River

Project/Action	Tasks involved, sub-actions, barriers to implementation	Limiting factors to address
Elevate US101 across estuarine delta to restore tidal connectivity, reestablish native vegetation	-would require working with WSDOT and Federal highway agencies in the development and implementation	Loss of channel complexity (large woody debris, channel condition, loss of side channel, channel instability) and floodplain loss -Estuarine and nearshore habitat loss and degradation
Reconnect northern distributary channel with the Duckabush River	-should be done in conjunction with reconfiguration of the US101 intersection with Duckabush River Road	-loss of channel complexity (large woody debris, channel condition, loss of side channel, channel instability) and floodplain loss -Estuarine and nearshore habitat loss and degradation
Remove dike along north side of estuary along Robinson Road	-already WDFW ownership	-estuarine and nearshore habitat loss and degradation
Reconfigure intersection of US101 and Duckabush River Road to reconnect Pierce Creek Slough	-would require working with WSDOT and Federal highway agencies in the development and implementation	-loss of channel complexity (large woody debris, channel condition, loss of side channel, channel instability) and floodplain loss -estuarine and nearshore habitat loss and degradation
Remove levees and rip rap in lower river to restore sinuosity	-significant land purchase effort would be need to complete this project	-loss of channel complexity (large woody debris, channel condition, loss of side channel, channel instability) and floodplain loss
Restore native plants in estuary area	-would need to work with landowners to develop a program and gain access	-estuarine and nearshore habitat loss and degradation
Restore native vegetation in mainstem	-would need to work with landowners to develop a program and gain access	-riparian degradation

To most effectively address those factors that are likely affecting the performance of the Dosewallips spawning aggregation, the SRP recommends the following projects summarized in Table 9.12.

Table 9.12. SRP recommended projects for the Dosewallips spawning aggregation.

Dosewallips River

Project/Action	Tasks involved, sub-actions, barriers to implementation	Limiting factors to address
Remove dikes in vicinity of mainstem Dosewallips River and estuary	-Remove levees on Dosewallips State Park lands -Brinnon levee an issue, but not much opportunity -Lazy C bank armoring -side channel should be reconnected on Bailey property -Rocky Brook confluence -Elkhorn campground and Steelhead camp Remove dike between Wolcott Slough and the Dosewallips mainstem on WA Parks ownership -could be part of a comprehensive floodplain management plan involving State Parks and the community of Brinnon	-estuarine habitat loss and degradation (diking, filling, log storage, road causeways) -loss of channel complexity (large woody debris, channel condition, loss of side channel, channel instability) and floodplain loss
Wolcott Slough: replace US 101 culvert at northern part of Wolcott Slough with a bridge, provide tidal channel connection with bridgeway over access road to east of US101, replace undersized culvert with bridge over slough to the south, remove dikes, connect upper tidal channel west of US101 with larger lagoon and with a bridge on the access road	-remove levees and dikes -replace culverts -remove US Highway 101 causeway -will need to involve planning with WSDOT and Federal highway agencies	-estuarine habitat loss and degradation (diking, filling, log storage, road causeways)
Remove barge at mouth of Walker Creek	-work with private landowner to develop feasibility plan	-estuarine habitat loss and degradation (diking, filling, log storage, road causeways)
Restore Sylopash slough tidal prism and riparian area	-work with private landowner to develop feasibility plan	-estuarine habitat loss and degradation (diking, filling, log storage, road causeways)

Acquire lands to protect and allow restoration opportunity	-acquire powerlines reach -acquire land at Rocky Brook and areas downstream of USFS lands	-loss of channel complexity (large woody debris, channel condition, loss of side channel, channel instability) and floodplain loss -Sediment aggradation